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PATENT
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MOTOR COOLING AND EXHAUST DILUTING BLOWER
HOUSING WITH HEAT SHIELD AND NOISE MUFFLER

This patent application is a continuation-in-part of patent application
Serial No. 10/116, 315 filed April 4, 2002, which is currently pending

Background of the Invention

(1) Field of the Invention

The present invention pertains to a blower housing that may be used with a climate control furnace or a water heater. The blower housing provides cooling of the motor that rotates the blower fan and provides dilution and cooling of exhaust gases drawn from the furnace or water heater. The housing is constructed of only two pieces in one embodiment, and five pieces in a second embodiment, and is designed to be easily mounted to a flat surface of the furnace or water heater.

(2) Description of the Related Art

Home or office furnaces and/or water heaters typically include a blower that operates to draw ambient air into the combustion chamber of the furnace or water heater and to expel exhaust gases or fumes from the furnace or

5 water heater through an exhaust pipe or chimney. The typical blower includes a blower housing having a volute shape and a radial fan or a squirrel cage fan mounted in the blower housing. The blower housing has an inlet vent opening at its center communicating with the center of the fan and an outlet exhaust opening at the periphery of the volute shape communicating with the exhaust pipe or chimney. An electric motor is mounted to the blower housing on an opposite side of the housing from the inlet vent opening. The motor rotates the fan to cause the fan to draw exhaust gases and fumes into the center of the fan in the blower housing through the inlet vent opening and exhaust the gases and fumes from the housing through the outlet exhaust opening.

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15 In use of the typical blower with a typical furnace, the inlet vent opening of the housing communicates with an outlet of the furnace heat exchanger. On operation of the blower motor and rotation of the blower fan, a vacuum is created by the fan in the blower housing that draws ambient air into the combustion chamber of the furnace where it mixes with the gas or other fuel

20 combusted in the combustion chamber. The hot combustion gases and fumes produced by the combustion chamber are then drawn through the heat exchanger of the furnace by the blower. The blower fan draws the combustion gases and fumes from the heat exchanger into the blower housing and expels the combustion gases and fumes through the exhaust pipe or chimney communicating with the exhaust outlet of the blower housing.

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The typical operation of the blower employed with a water heater is similar to that of the furnace. On operation of the blower, ambient air is drawn into the combustion chamber where it mixes with the gas or other fuel being combusted. The combustion gases and fumes are then drawn through the

5 heat exchanger of the water heater where they heat the water contained in the heater. The combustion gases and fumes are then drawn from the heat exchanger and through the blower housing and are expelled through the exhaust pipe or chimney by the blower.

Improvements in the typical blower used with a furnace or a water heater have included modifications to the blower housing where rotation of the fan not only draws the combustion gases and fumes from the heat exchanger of the furnace or water heater into the housing before being expelled, but the fan also draws a flow of cooling air over the motor rotating the fan to cool the motor. Modifications to the blower housing have also enabled ambient air to

10 be drawn directly into the blower housing to mix with the heated exhaust gases and fumes drawn into the blower housing to dilute and cool the exhaust gases and fumes with the ambient air prior to their being expelled through the exhaust pipe or chimney communicating with the blower housing. However, these modifications to the typical blower housing have complicated the

15 constructions of the blower housing which increases their manufacturing cost.

In addition, the modifications to the typical blower housing have also complicated the assembly of the blower housing to the furnace or water heater with which it is used, resulting in increasing the time required to

20 assemble the housing to the furnace or water heater and thereby increasing the assembly cost of the furnace or water heater. Still further, providing an

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opening in the blower housing to enable ambient air to be drawn directly into the housing to mix with the heated exhaust gases and fumes to cool the exhaust gases and fumes also enables the noise of operation of the motor and fan to escape from the blower housing. A person's fingers could also be 5 inserted through the opening and come into contact with the moving parts of the motor, causing injury to the person's fingers. The heated exhaust gases and fumes drawn into the blower housing also heat up the portion of the blower housing that directs the gases and fumes into the fan. A person's hand contacting this portion of the blower housing could result in serious 10 burns to the hand.

What is needed to overcome these disadvantages of prior art blower 15 housings used with climate control furnaces and water heaters is a blower housing that provides the benefits of motor cooling and exhaust gas dilution and cooling in a simplified, inexpensive blower housing that is easily assembled to the furnace or water heater with which it is used. The blower housing would also include safety features that would guard against a person inserting their fingers through the opening in the blower housing provided for ambient air and would also insulate portions of the blower housing to prevent a person's hand from being burned when contacting the exterior surface of 20 the blower housing. The blower housing construction would also reduce the noise of motor and fan operation transmitted through the ambient air opening of the housing.

Summary of the Invention

The blower housing of the present invention overcomes disadvantages associated with prior art blower housings discussed earlier by providing a blower housing that both draws cooling air over the motor rotating the fan

5 contained in the blower housing and draws cooling and diluting air into the exhaust gases and fumes drawn into the blower housing, where the blower housing has a simplified, inexpensive two-piece construction. In addition, the blower housing provides a compartment for the electrical circuitry that controls operation of the blower motor that encloses all of the circuitry components

10 associated with the motor in the blower housing. Still further, the housing is designed with one side of the housing being positioned in a single plane that facilitates mounting of the one side of the housing on a flat surface of the furnace or water heater with which the blower is used. In addition, a second embodiment of the blower housing is provided with a noise muffler that is

15 positioned over the opening to the housing through which ambient air is drawn to cool the motor and dilute the exhaust gases and fumes. The muffler reduces the noise created by the operation of the motor and fan. The muffler also functions as a protective cover over the opening, preventing the insertion of a person's fingers through the opening where they could be injured by

20 contacting the moving parts of the operating motor. The blower housing would also be provided with a double-layered wall in the portion of the housing that directs the heated exhaust gases and fumes drawn into the blower housing to the fan. The double layers of the wall would be separated by a void or hollow volume that insulates the exterior layer of the double-

layered wall and prevents the exterior layer from heating up to the extent where it could cause injury to a person's hand contacting the exterior layer.

The motor cooling and exhaust diluting blower housing of the invention is constructed with a fan compartment that contains the radial or squirrel cage 5 fan of the blower. The fan compartment has a volute shape with an exhaust inlet opening in one side of the compartment and a shaft hole in an opposite side of the compartment. The peripheral wall of the volute-shaped fan compartment merges into a circular exhaust outlet opening.

The blower housing also has a motor compartment on the side of the 10 fan compartment having the shaft hole. The motor is supported in the motor compartment with the motor shaft passing through the shaft hole to the fan contained in the fan compartment. An inlet vent opening passes through the motor compartment on an opposite side of the motor compartment from the fan compartment. An outlet vent opening exits the motor compartment 15 adjacent its connection to the fan compartment. The inlet vent opening and the outlet vent opening of the motor compartment define a flow path of air that is drawn through the motor compartment on operation of the blower fan that cools the motor contained in the motor compartment. A muffler is mounted over the inlet vent opening and reduces the noise of operation of the motor 20 and fan transmitted through the inlet vent opening. In addition, the muffler is configured to prevent the fingers of a person's hand from being inserted through the inlet vent opening where they could be injured by contacting the operating motor.

The blower housing also includes a dilution compartment on the side of 25 the fan compartment through which the exhaust inlet opening passes. The

dilution compartment also communicates with the motor compartment through the vent outlet opening of the motor compartment. Thus, rotation of the fan in the fan housing draws exhaust gases through the dilution compartment and also draws cooling air through the motor compartment and mixes that cooling

5 air with the exhaust gases in the dilution compartment before the mixed air and gases are drawn into the fan compartment. In the second embodiment of the blower housing, the dilution compartment has a double-layered wall where the heated exhaust gases and fumes are directed by the double-layered wall from the dilution compartment to the fan compartment. The two layers of the

10 double-layered wall are separated by a hollow void that insulates the exterior layer of the double-layered wall from the heat of the exhaust gases.

The blower housing also includes a circuitry compartment that contains the electronic circuitry associated with the blower motor. The circuitry compartment is isolated from the fan compartment, the motor compartment

15 and the dilution compartment except for a small opening to the motor compartment that allows the electric wiring of the motor to pass into the circuitry compartment and a small opening to the fan housing that allow a pressure sensor mounted in the fan compartment to communicate with the circuitry in the circuitry compartment. In the second embodiment of the

20 blower housing the exterior wall of the circuitry compartment is removable, providing easy access to the circuitry.

Because much of the electronic circuitry that controls the operation of the blower motor is mounted on the exterior of the furnace or water heater with which the blower is used, the circuitry compartment is located at the side

25 of the blower housing that is positioned in a single plane. In addition, because

the dilution compartment communicates with the exhaust outlet of the furnace or water heater, the dilution compartment is also located at the side of the blower housing that is positioned in the single plane. This enables the blower housing to be mounted to a flat surface of the furnace or water heater with the

5 circuitry compartment enclosing the circuitry components mounted on the flat surface and the dilution compartment enclosing the exhaust outlet of the furnace or water heater emerging from the flat surface.

The arrangements of the fan compartment, the motor compartment, the dilution compartment and the circuitry compartment in the blower housing

10 enable the blower housing to be constructed of only two pieces in one embodiment, or five pieces in the embodiment having the noise muffler and the double-layered wall, with each piece being moldable of plastic or another similar material. In the two-piece housing construction, portions of the fan compartment, the motor compartment and the dilution compartment are

15 provided on each piece to facilitate assembly of the fan and motor in their respective compartments.

Descriptions of the Drawings

Further features of the invention are set forth in the following detailed

20 description of the invention and in the drawing figures wherein:

Figure 1 is a perspective view of one side of the assembled two-piece blower housing embodiment of the invention;

Figure 2 is a perspective view of the opposite side of the blower housing shown in Figure 1;

Figure 3 is a side elevation view of the assembled two-piece blower housing of the invention;

Figure 4 is an elevation view of the side of the blower housing opposite that shown in Figure 3;

5 Figure 5 is an end elevation view of the blower housing of Figure 3;

Figure 6 is an elevation view of the opposite end of the blower housing from that shown in Figure 5;

Figure 7 is a top plan view of the blower housing of Figure 3;

Figure 8 is a bottom plan view of the blower housing of Figure 3;

10 Figure 9 is a bottom perspective view of the top piece of the blower housing;

Figure 10 is a top perspective view of the housing top piece;

Figure 11 is a further top perspective view of the housing top piece;

15 Figure 12 is a top perspective view of the bottom piece of the blower housing;

Figure 13 is a bottom perspective view of the housing bottom piece;

Figure 14 is a sectioned view of one side of the assembled blower housing;

20 Figure 15 is a perspective view of a second embodiment of the blower housing of the invention which is comprised of three housing pieces and a muffler and internal heat shield;

Figure 16 is a perspective view of the blower housing of Figure 15 rotated clockwise 90° and with a condensate collector attached to the exhaust conduit;

25 Figure 17 is a bottom view of the blower housing of Figure 15; and,

Figure 18 is a sectioned side view of the blower housing of Figure 15.

Detailed Description of a Preferred Embodiment

As explained earlier, the blower housing of the invention has a simplified, inexpensive construction and is constructed to both draw cooling air over the motor rotating the fan of the blower and draw cooling and diluting air into the exhaust gases and fumes drawn into the blower housing by the fan. Because the specific construction of the fan, motor and motor electronic circuitry employed with the blower housing are not pertinent to the novel construction of the blower housing itself, these component parts of the blower are shown only schematically in the drawings. In addition, because the novel blower housing of the invention may be employed with a heating furnace or a water heater, the particular construction of the furnace or water heater is not shown in the drawing figures. Only the exhaust gas or fume exit pipe emerging from a flat surface of the furnace or water heater are shown in the drawing figures to illustrate the novel construction of the blower housing that enables it to be easily mounted to the furnace or water heater with which it is used. In the preferred embodiment of the invention, the two pieces of the blower housing to be described are molded of a plastic material. However, other similar types of materials and similar methods of manufacture may be employed.

As shown in the drawing figures, a first embodiment of the blower housing (12) of the present invention consists of two pieces including a first, top piece (14) and a second, bottom piece (16). The blower housing (12) is shown in Figures 1 and 2 mounted on top of a flat surface (18) of a furnace or

water heater relative to the exhaust exit pipe (22) of the heater. Thus, describing the two pieces of the housing as a top piece and bottom piece describe only the relative positions of the two pieces when the housing is mounted on a top surface (18) of a heater. The blower housing (12) is equally

5 well suited for mounting on the flat side surface of a furnace or water heater and therefore the terms "top" and "bottom" used in describing the two housing pieces should not be interpreted as limiting.

The blower housing is constructed with a fan compartment (26) that is enclosed between first and second end walls (28, 32) that are spaced from

10 each other by a volute shaped side wall (34). The side wall (34) spirals around the peripheral edges of the two end walls (28, 32) to a generally cylindrical exhaust exit conduit (36) that emerges from the side wall (34) of the fan compartment. The conduit (36) surrounds an exhaust outlet opening (38) of the fan compartment (26) that communicates with a combustion gas or

15 fume exhaust pipe or chimney (not shown) in use of the blower housing. A shaft hole (42) is provided through the first end wall (28) of the fan compartment and an exhaust inlet opening (44) is provided through the opposite, second end wall (32) of the fan compartment. A pressure sensor opening (46) also passes through the side wall (34) of the fan compartment.

20 As seen in the drawing figures, the two-piece construction of the blower housing (14) divides the fan compartment (26) into a first portion (26a) of the fan compartment and a second portion (26b) of the fan compartment that separate from each other across the shaft hole (42) and the exhaust inlet opening (44). This enables the fan (48) to be easily assembled into the

25 interior of the fan compartment (26).

The blower housing (12) also includes a motor compartment (52). The motor compartment has opposite first (54) and second (56) end walls, opposite first (58) and second (60) side walls and opposite top (62) and bottom (64) walls. The motor compartment first end wall (54) is actually a

5 portion of the fan compartment first end wall (28) that has the shaft hole (42) extending therethrough. A cylindrical inlet vent collar (66) projects from the motor compartment second end wall (56) and surrounds an inlet vent opening (68) to the motor compartment interior. An outlet vent opening (72) passes through the motor compartment bottom wall (64) adjacent the fan

10 compartment first end wall (28). An additional motor electrical wiring hole (74) passes through the motor compartment bottom wall (64). Motor supports (76) project inwardly from the opposite motor compartment top wall (62) and bottom wall (64) and support the motor (78) in a centered position in the motor compartment interior with the motor shaft (82) projecting through the shaft

15 hole (42) to the fan (48) contained in the fan compartment (26). In use of the blower housing, an ambient air inlet conduit (not shown) is connected to the inlet vent collar (66) to supply cooling, ambient air to the interior of the motor compartment (52). The cooling air circulates around the motor (72) that is centered in the interior of the motor compartment (52) before exiting the motor

20 compartment through the outlet vent opening (72).

The two-piece construction of the blower housing (12) divides the motor compartment into a first portion (52a) of the motor compartment and a second portion (52b) of the motor compartment. The line of separation between the two motor compartment portions (52a, 52b) crosses the motor

shaft hole (42) and the inlet vent collar (66), facilitating the assembly of the motor (72) into the interior of the motor compartment (52).

The two-piece blower housing (12) also has a dilution compartment (86) on an opposite side of the fan compartment (26) from the motor 5 compartment (52). The dilution compartment (86) has a tombstone shaped side wall (88) that is best seen in Figure 8. A top wall (92) extends over the side wall (88) of the dilution compartment and merges with portions of the walls of the fan compartment (26) and the motor compartment (52). A cowling wall (94) extends upwardly from the dilution compartment top wall (92) and 10 merges with the fan compartment second end wall (32). The cowling wall (94) extends around the exhaust inlet opening (44) that passes through the fan compartment second end wall (32), thereby communicating the interior of the dilution compartment (86) with the interior of the fan compartment (26) through the exhaust inlet opening (44). As best seen in Figure 8, the dilution 15 compartment side wall (88) also extends around the motor compartment outlet vent opening (72), thereby communicating the interior of the dilution compartment (86) with the interior of the motor compartment (52) through the outlet vent opening (72). The two-piece construction of the blower housing (12) also divides the dilution compartment into a first portion (86a) of the dilution compartment and a second portion (86b) of the dilution compartment. 20 The dilution compartment side wall (88) has a side wall flange (96) that projects outwardly from the side wall. The flange (96) is employed in attaching the blower housing assembly (12) to the flat surface of a heater with which the housing is used by passing threaded fasteners through the flange

and the heater surface or by employing adhesives or other equivalent means of attaching the housing to the heater surface.

The blower housing (12) also includes a circuitry compartment (102) that extends below the motor compartment (52) and along portions of the 5 sides of the motor compartment (52), the fan compartment (26) and the dilution compartment (86). Thus, portions of the walls of these compartments in combination with a pair of opposite end walls (104, 106), a side wall (108) and a top wall (112) of the circuitry compartment enclose the interior of the compartment. The circuitry compartment contains the electronic circuitry 10 associated with the blower motor (78) and isolates the circuitry from the fan compartment (26), the motor compartment (52) and the dilution compartment (86) except for the motor wiring hole (74) and the pressure sensor opening (46). The circuitry contained in the circuitry compartment (102) includes the motor wiring (114) that passes through the motor wiring hole (74) and the 15 pressure sensor (116) that is positioned in the pressure sensor opening (46). Several openings (118) are provided through the circuitry compartment side wall (108) for mounting switches (120) and electrical couplings (122) in the side wall that communicate with the circuitry components contained in the interior of the circuitry compartment (102). Thus, the circuitry compartment 20 (102) contains and protects the circuitry components associated with the electric motor (78) and the pressure sensor (116) as well as other sensors and switches that are typically employed in controlling the operation of the blower motor (78) of a typical furnace or water heater. The two-piece construction of the blower housing (12) also separates the circuitry 25 compartment into a first portion (104a) and a second portion (104b) of the

compartment that separate from each other to enable easy access into the interior of the circuitry compartment (102) that facilitates assembly of the circuitry components into the blower housing.

Because much of the electronic circuitry that controls the operation of

5 the blower motor is typically mounted on the exterior surface (18) of the furnace or water heater with which the blower is used, the circuitry compartment (102) is located at a side of the blower housing (12) that is positioned in a single plane represented by a line (124) shown in Figures 1 and 2. In addition, because the dilution compartment (86) communicates with

10 the exhaust exit pipe (22) of the furnace or water heater, the dilution compartment (86) is also located at the side of the blower housing that is positioned in the single plane (124). This enables the blower housing (12) to be mounted to a flat surface (18) of the furnace or water heater with the circuitry compartment (102) enclosing the circuitry components mounted on

15 the flat surface and with the dilution compartment (86) enclosing the exhaust exit pipe (22) of the furnace or water heater emerging from the flat surface.

The arrangement of the fan compartment (26), the motor compartment (52), the dilution compartment (86) and the circuitry compartment (102) in the blower housing described above enable the blower housing to be constructed

20 of only two pieces with each piece being moldable of plastic or other similar material in a two-piece mold. In the two-piece housing construction, portions of the fan compartment (26), the motor compartment (52), the dilution compartment (86) and the circuitry compartment (102) are provided on each piece to facilitate assembly of the fan, the motor and the circuitry in their

25 respective compartments. In addition, the arrangement of the compartments

provides a flow path of cooling air drawn into the motor compartment (52) through the inlet vent opening (86) on actuation of the motor (78) and rotation of the fan (48). The cooling air is drawn around the motor (78) cooling the motor and exits the motor compartment through the outlet vent opening (72)

5 at the bottom of the compartment. The air is then drawn into the dilution compartment (86) where it cools and dilutes exhaust gases and fumes that exit the furnace or water heater through the exhaust exit pipe (22). The cooled and diluted exhaust gases and fumes are then drawn into the fan compartment (26) through the exhaust inlet opening (44) and are expelled

10 from the blower housing through the exhaust conduit outlet opening (38) to the exhaust pipe or chimney (not shown) communicating with the exhaust exit conduit (36). Thus, the two-piece blower housing provides cooling of the motor that rotates the blower fan and provides dilution and cooling of exhaust gases and fumes drawn from the furnace or water heater and is also easily

15 mounted to a flat surface of the furnace or water heater.

Figures 15-18 show a second embodiment of the blower housing (132) of the present invention that consists of five housing pieces. Many of the housing pieces are substantially the same as those of the first described embodiment of the blower housing (12). Therefore, these common housing

20 pieces will not be described again in detail. Instead, the description of the blower housing of Figures 15-18 will concentrate on the differences in the construction of the blower housing from that of the first embodiment of the blower housing. The common features of the second embodiment of the blower housing (132) to that of the first embodiment of the blower housing

25 (12) are identified by the same reference numbers employed in describing

these features of the first embodiment of the blower housing, followed by a prime(').

The second embodiment of the blower housing (132) also includes a circuitry compartment (134) that extends below the motor compartment (52').

- 5 The circuitry compartment (134) also extends along portions of the side of the motor compartment (52'), the fan compartment (26') and the dilution or exhaust compartment (86') as seen in Figures 15, 17, and 18. Thus, portions of the walls of these compartments, in combination with a pair of opposite end walls (104', 106'), and a side wall (108') of the circuitry compartment enclose
- 10 the interior of the compartment. As in the first described embodiment, the circuitry compartment (134) contains the electronic circuitry associated with the blower motor (78') and isolates the circuitry from the fan compartment (26'), the motor compartment (52') and the dilution/exhaust compartment (86') except for the motor wiring hole (74') and the pressure sensor opening (46').

- 15 The circuitry compartment 134 of the second embodiment differs from that of the first embodiment in that the top of the compartment is removable from both the blower housing top piece (14') and the blower housing bottom piece (16'). As best seen in Figure 15, the circuitry compartment comprises an upper end wall section (136), an upper side wall section (138), and a top wall (142) that can be separated from the blower housing top piece (14') and the blower housing bottom piece (16'). A pair of fastener tabs (144) are provided on the circuitry compartment top wall 142 and align with a pair of fastener tabs (146) on the blower housing top piece (14'). Threaded fasteners can be inserted through the opposed pairs of tabs (144) (146) to removably
- 20 attach the top piece of the circuitry compartment (134) to the blower housing
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top piece (14') and the blower housing bottom piece (16'). Removing the fasteners enables the easy removal of the top piece of the circuitry compartment (134) to enable repair or replacement of any of the circuitry components.

5 The dilution compartment or exhaust compartment (86'), like the first embodiment, is positioned on an opposite side of the fan compartment (26') from the motor compartment (52'). The dilution/exhaust compartment (86') has a tombstone-shaped side wall (88') and a top wall (92') that extends over the side wall and merges with portions of the walls of the fan compartment 10 (26') and the motor compartment (52'). A cowling wall (94') extends upwardly from the dilution/exhaust compartment top wall (92') and merges with the fan compartment second end wall (32'). The cowling wall (94') extends around the exhaust inlet opening (44') that passes through the fan compartment second end wall (32'), thereby communicating the interior of the 15 dilution/exhaust compartment (86') with the interior of the fan compartment (26') through the exhaust inlet opening (44'). The dilution/exhaust side wall (88') also extends around the motor compartment outlet vent opening (72'), thereby communicating the interior of the dilution/exhaust compartment (86') with the interior of the motor compartment (52') through the outlet vent 20 opening (72').

 The dilution compartment side wall (88') has a side wall flange (96') that projects outwardly from the side wall. The flange (96') is employed in attaching the blower housing assembly (12') to the flat surface of a heater (154) with which the housing is used. The blower housing assembly is 25 attached to the heater surface (154) by passing threaded fasteners through

the flange and the heater surface, or by employing adhesives or other equivalent means of attaching the housing to the heater surface. The exhaust compartment flange (96') defines an exhaust compartment opening that receives exhaust gases from the separate heater to which the blower housing

5 (132) has been attached.

The dilution/exhaust compartment (152) of the second embodiment differs from that of the first embodiment in that it is provided with a layered wall construction. An exterior layer of the layered wall construction is provided by the cowling wall (94') that extends from adjacent the exhaust compartment opening defined by the exhaust compartment flange (96'), to the fan compartment opening or the exhaust inlet opening (44') of the fan compartment.

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The interior layer of the layered wall construction is provided by a heat shield (156) inside the dilution/exhaust compartment (152). As shown in Figures 17 and 18, the heat shield (156) has a configuration that matches the interior surface of the dilution/exhaust compartment cowling wall (94'). The heat shield (156) has a curved length that extends from adjacent the exhaust compartment opening defined by the exhaust compartment flange (96') to the fan compartment opening or the exhaust inlet opening (44') of the fan compartment (26'). The heat shield (156) also has a concave configuration in cross-section that is received inside the concave cross-section configuration of the cowling wall (94'). This configuration gives the heat shield (156) an arch-shaped input end (158) and an arch-shaped output end (162). An arch-shaped flange (164) extends around the arch-shaped output end (162). The flange (164) engages in a slot (166) in the interior of the blower housing

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between the fan compartment second end wall (32') and the dilution/exhaust compartment cowling wall (94'). An arch-shaped flange (168) also extends around the input end (158) of the heat shield (156). This flange (168) has several flat tabs (172) that project outwardly from the flange. The tabs (172)

5 receive threaded fasteners that pass through the tabs and into the blower housing. Together the arch-shaped flange (164) at the heat shield output end (162), and the fasteners that extend through the fastener tabs (172) into the blower housing secure the heat shield in place in the interior of the dilution/exhaust compartment (86'). In its position secured inside the

10 dilution/exhaust compartment (86'), the heat shield (156) is opposite the exhaust compartment opening defined by the exhaust compartment flange (96'). The curved configuration of the heat shield (156) directs hot exhaust gases and fumes from the input end (158) of the heat shield adjacent the exhaust compartment opening defined by the exhaust compartment flange

15 (96'), to the opposite output end (162) of the heat shield adjacent the fan compartment opening or the exhaust inlet opening (44') of the fan compartment (26'). In addition, the heat shield (156) is secured inside the interior of the dilution/exhaust compartment (86') with there being a spacing or hollow void (174) between the heat shield (156) and the interior surface of the

20 cowling wall (94'). This space or hollow void (174) insulates the exterior layer or cowling wall (94') of the layered wall construction from the heat of the exhaust gases and fumes that are directed toward the heat shield (156). The insulation provided by the space or hollow void (174) enables a person's hand to come into contact with the exterior surface of the cowling wall (94') without

25 being burned by the exhaust gases and fumes that contact with the heat

shield (156). The shield (156) and void (174) also function to provide sound insulation to the blower housing.

A guard or sound muffler (176) is removably attached over the cylindrical vent collar (66') that extends around the inlet vent opening (68') to 5 the motor compartment interior. The guard has a cylindrical sleeve (178) that fits in a snug fit around the inlet vent collar (66'). An adjustable band (not shown) is positioned around the guard sleeve (178) and tightened to removably secure the guard (176) to the inlet vent collar (66'). The guard (176) is formed with a cowling that intersects the guard sleeve (178). The 10 cowling is defined by an inner side wall (182), an opposite outer side wall (184) that is spaced from the inner side wall, and a top wall (186) that extends over the inner side wall and the outer side wall. A pair of interior webs (188) extend between and reinforce the inner side wall (182) and the outer side wall (184). A guard/muffler opening (192) is defined by the bottom edges of the 15 inner side wall (182), the outer side wall (184), and the opposite bottom edges of the top wall (186). The guard/muffler opening (192) is positioned in a plane that is oriented at an angle relative to the plane in which the inlet vent opening (68') is positioned. This creates a non-linear flow path of ambient air through the interior of the guard/muffler (176) to the interior of the motor compartment 20 (52'). This non-linear flow path muffles the noise generated by the motor (78') in the motor compartment (52'). In addition, the positioning of the outer side wall (184) directly opposite the inlet vent opening (68') of the motor compartment (52') prevents the insertion of a person's fingers into the moving component parts of the motor (78') in the motor compartment (52'). Thus, the 25 guard/sound muffler (176) provides the dual function of muffling the sound of

operation of the blower housing motor (78') and provides a protective barrier against the inadvertent insertion of a person's fingers through the inlet vent opening (68') of the blower motor housing.

While the present invention has been described by reference to a 5 specific embodiment, it should be understood that modifications and variations of the invention may be constructed without departing from the scope of the invention as defined by the following claims.